Objective 1 – Landscape ecology of BMSB

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Local vs. Landscape Factors

The Big Questions

1. Can we assess risk of invasion from BMSB across the US?

2. Can we assess factors that influence population dynamics of BMSB across the US?

3. Can we evaluate potential overlap between parasitoids (or other biological controls and BMSB)?

4. Can landscape-level data be used for outreach efforts?

Approach

1. Long-term monitoring in each region

2. Manipulative experiments examining host plant use, physiology, etc (some already conducted)

3. Geographical information systems

4. Statistical and mathematical models

Assessing Risk of Invasion

Occupancy modeling – relates presence/absence data and data on environmental variables to predict potential range

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PLoS one

Potential Geographic Distribution of Brown Marmorated Stink Bug Invasion (*Halyomorpha halys*)

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Occupancy modeling

Record data on species environmental tolerances (note, the issue is that it assumes all BMSB populations are equal)

Variables	Description
*BIO1	Annual mean temperature
*BIO5	Maximum temperature of warmest month
*BIO6	Minimum temperature of coldest month
*BIO12	Annual precipitation
BIO13	Precipitation of wettest month
BIO14	Precipitation of driest month
*BIO20	Annual mean radiation
BIO21	Highest weekly radiation
BIO22	Lowest weekly radiation
*DEM	Elevation

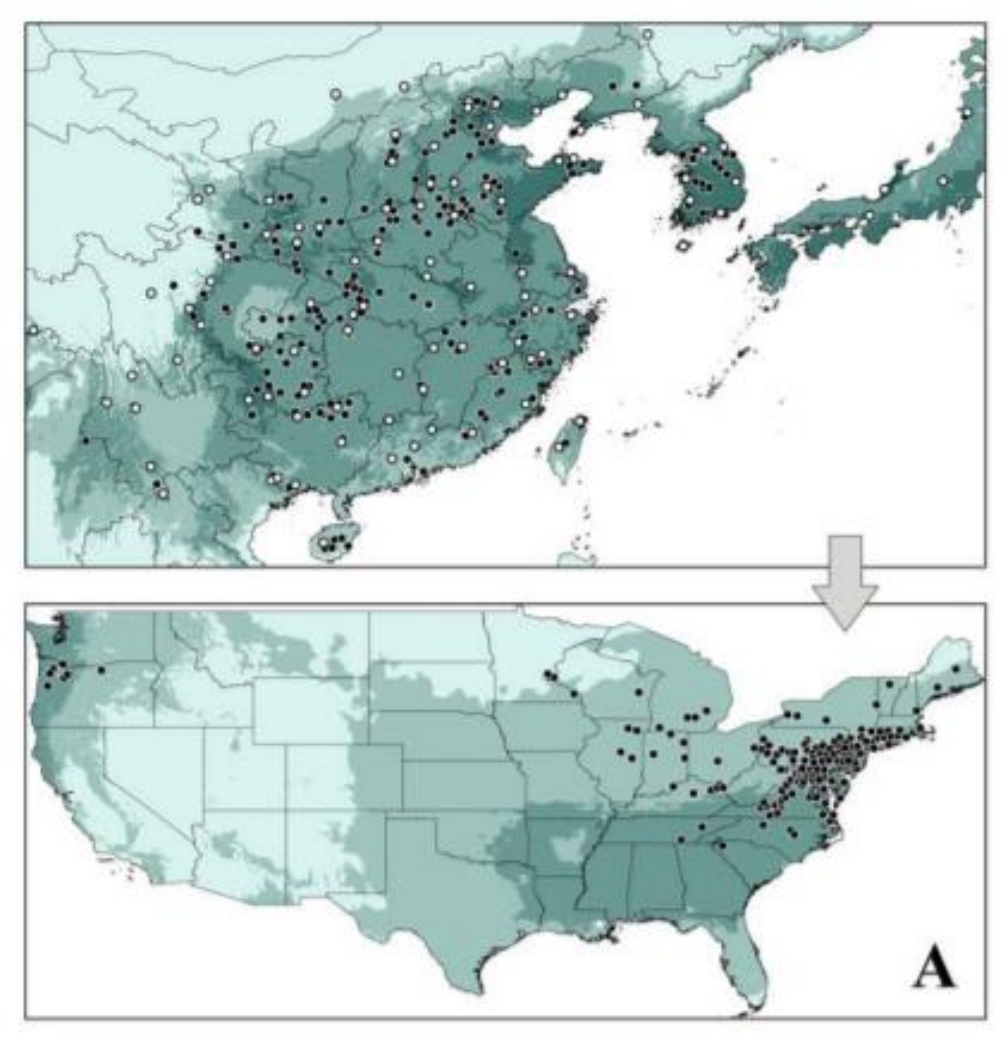
MaxEnt or Climex Approaches

Use data on presence (and in some cases) absence, environmental data from the landscape, and tolerances of a species to infer where it can survive across a landscape

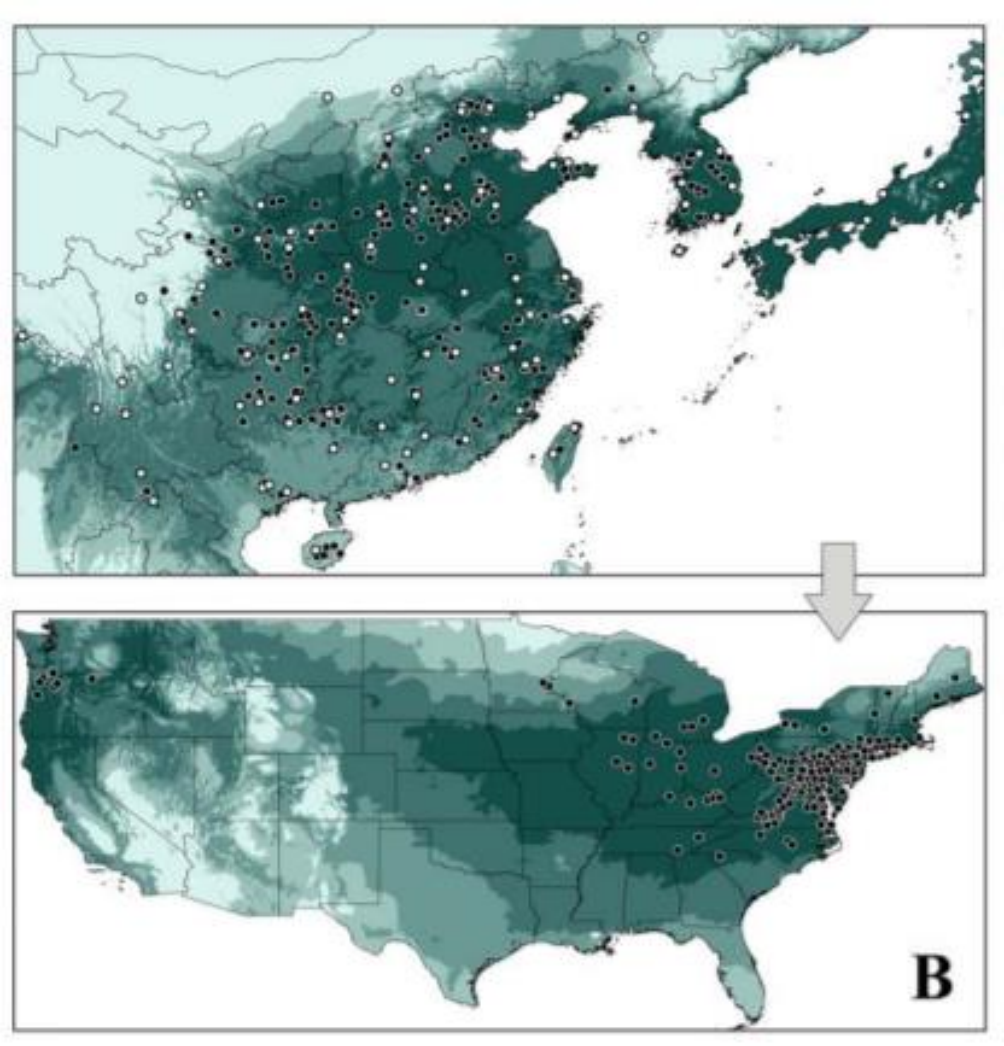
MaxEnt (Maximum Entropy) attempts to fit a smooth surface to all areas where BMSB could potentially survive, and assigns a probability of survival that declines towards the “edge”. Can allow for small datasets (> 20 samples)

Climex creates a climatic suitability index from pooled environmental variables and predicts distribution from this

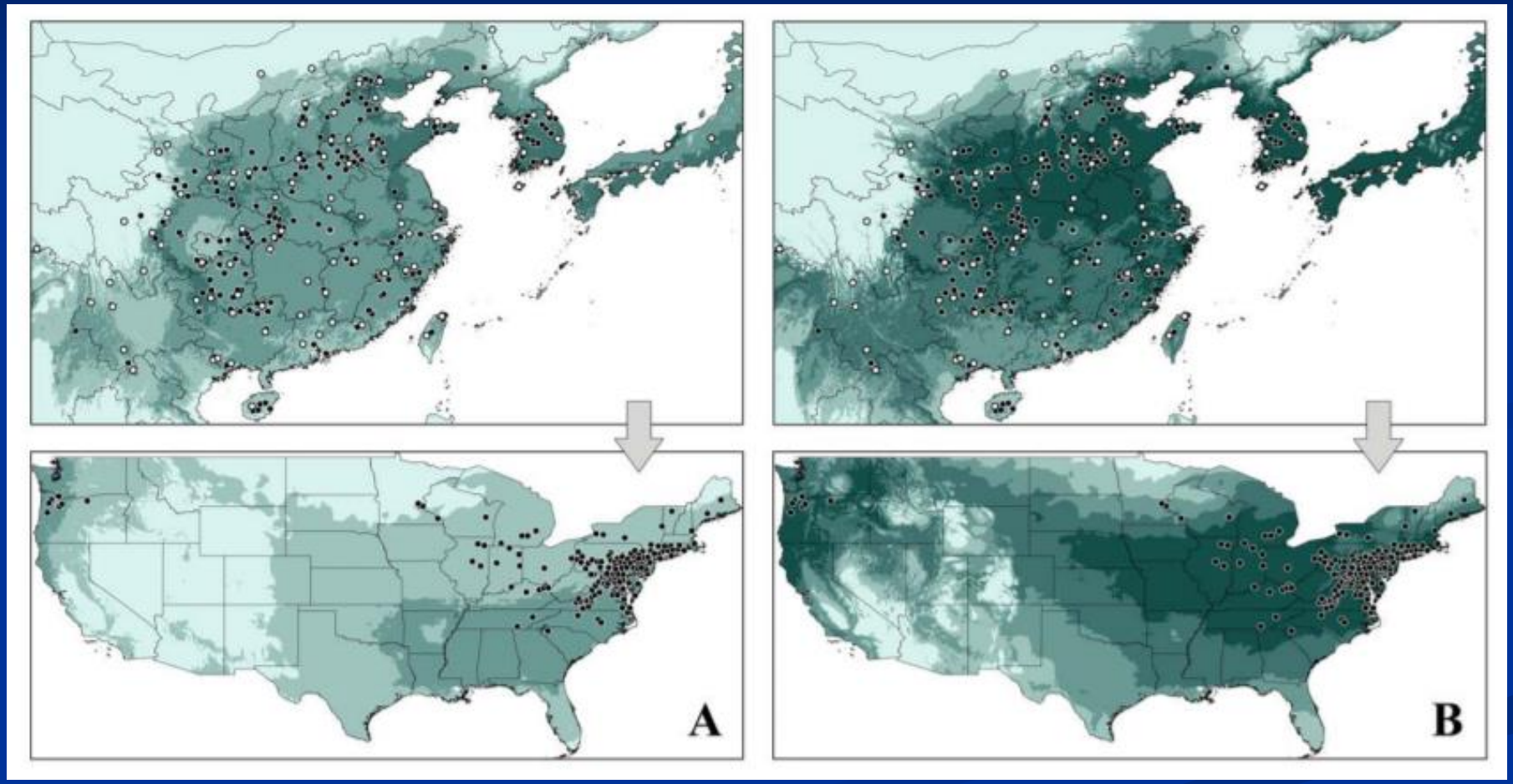
Model output (6 variables)



Model output (10 variables)



Models side by side

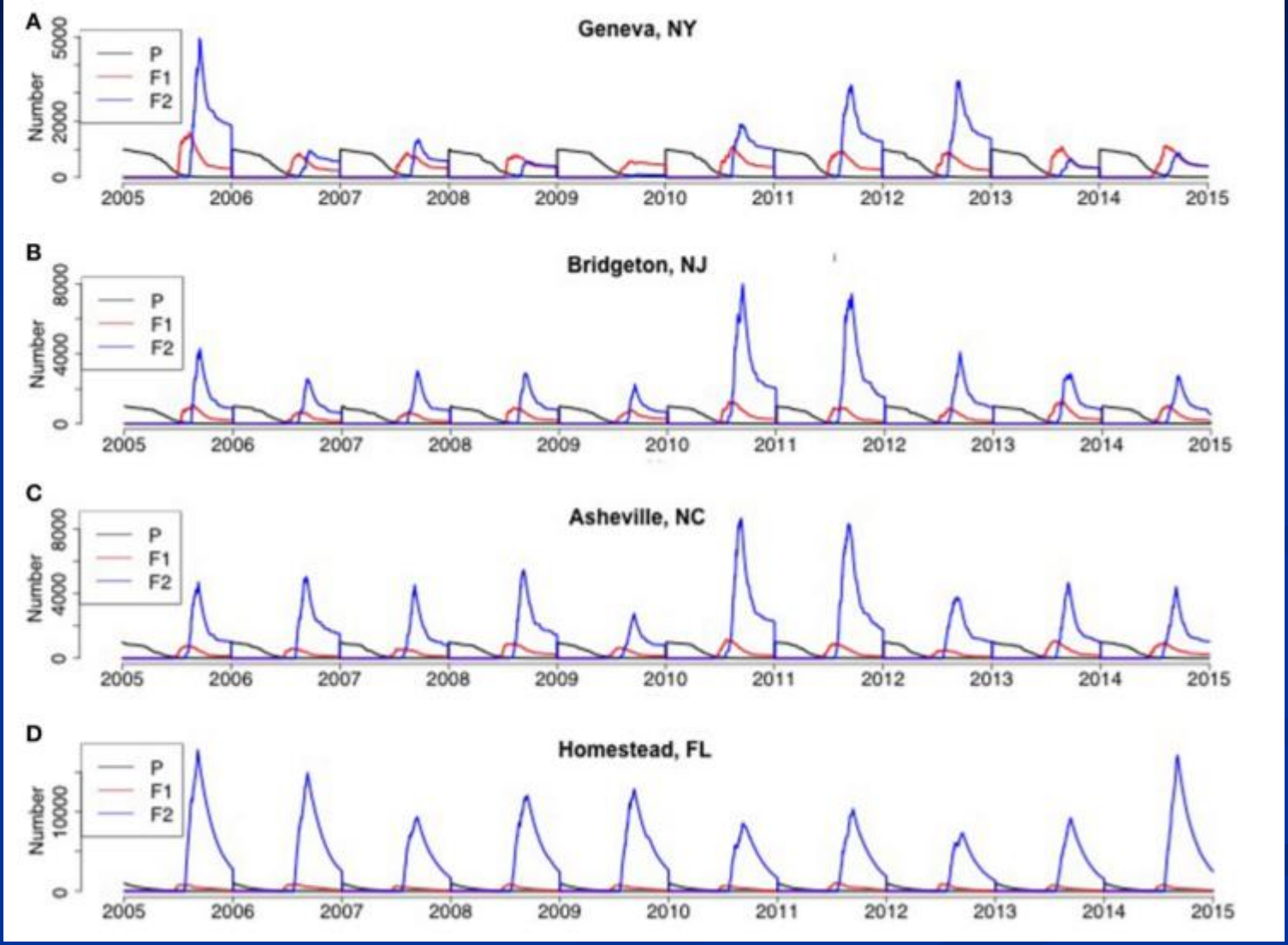


Limitations

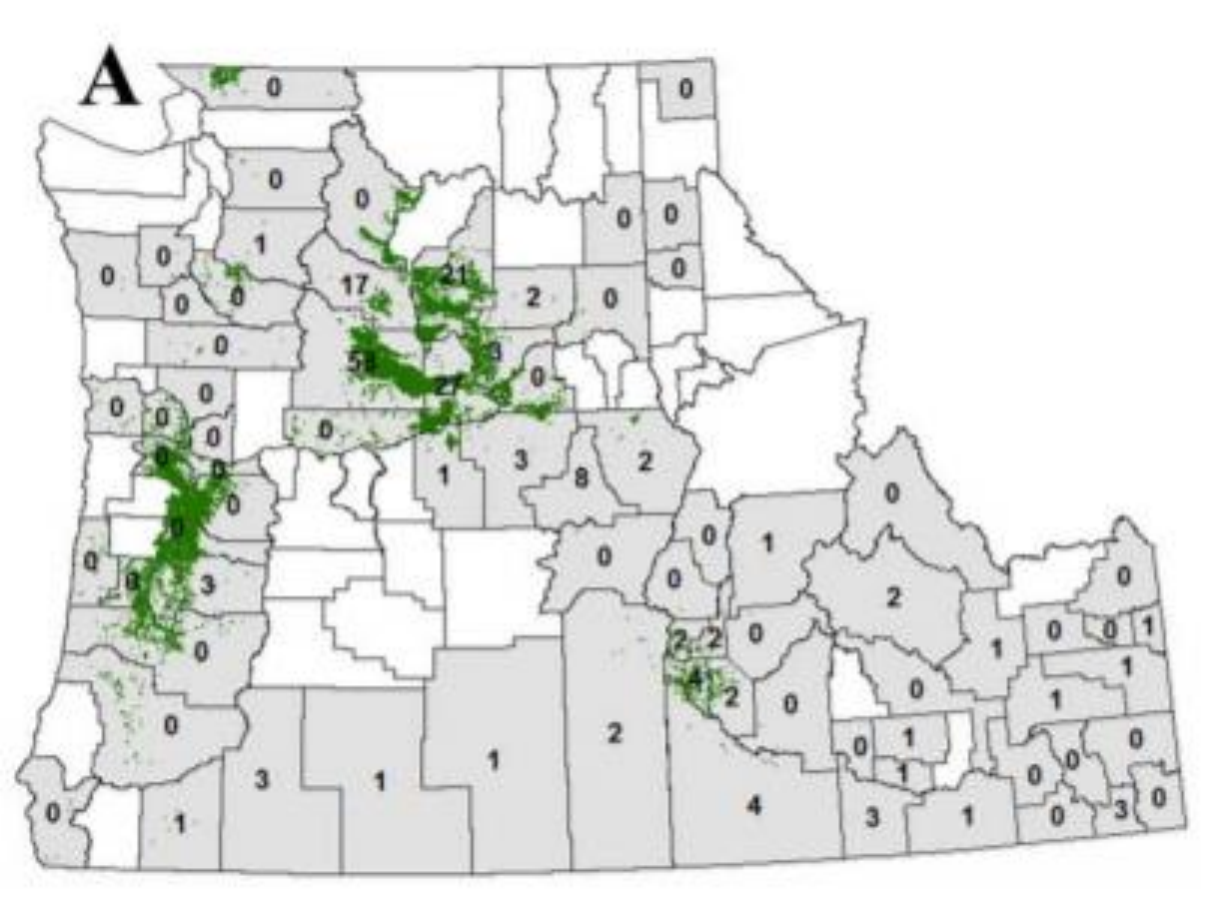
(1) No information on population dynamics

(2) If conditions aren't that variable, can generate relatively little information of use

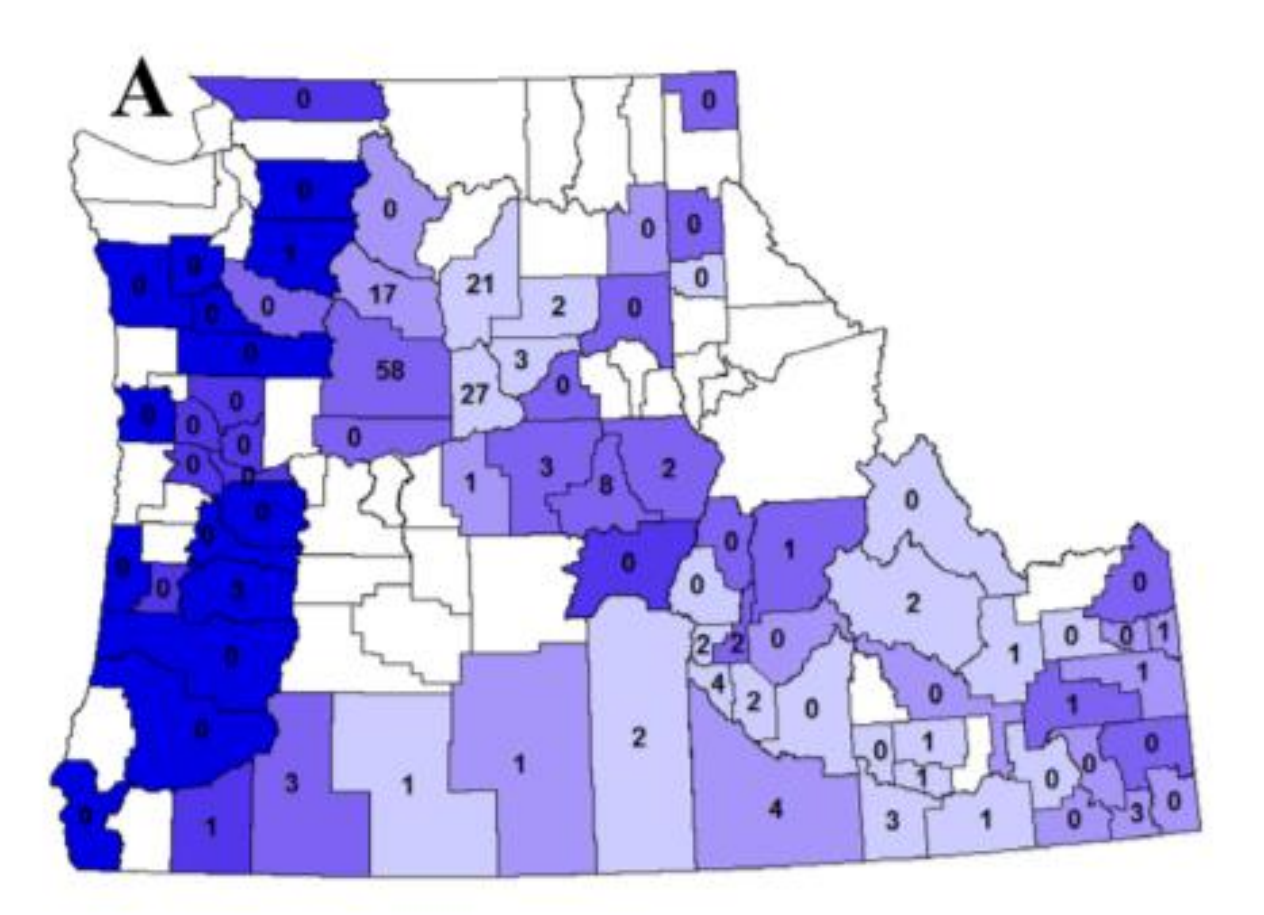
Modeling population dynamics



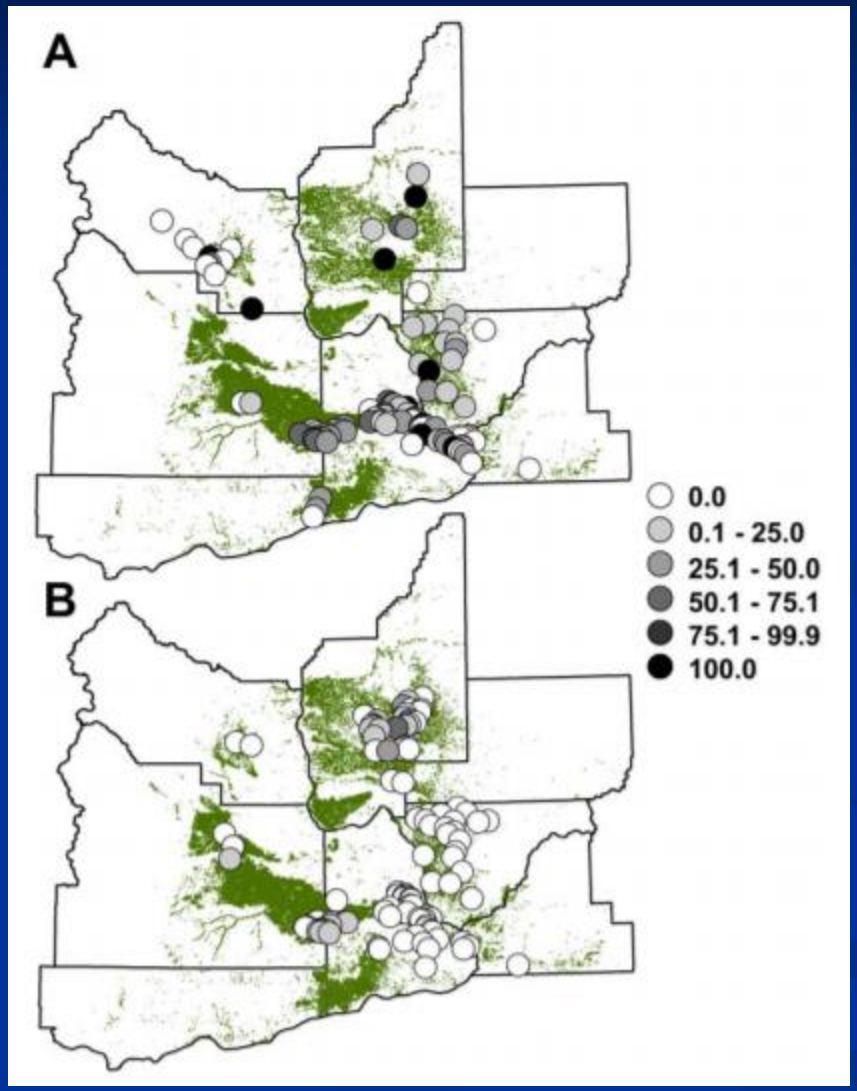
West Nile virus - landscape



West Nile virus - environment



West Nile virus - monitoring



West Nile virus - output

Response	Explanatory Variable									
	Temperature		Precipitation		Vegetable/forage		Orchard		Natural	
	Slope	*P*	Slope	*P*	Slope	*P*	Slope	*P*	Slope	*P*
Cx. pipiens abundance	−0.40	0.34	−0.24	0.51	−0.16	0.91	0.58	0.0002	0.082	0.51
Cx. tarsalis abundance	0.017	0.95	0.16	0.58	0.27	0.17	0.34	0.034	0.23	0.26
Cx pipiens+*Cx tarsalis* abundance	0.028	0.91	0.24	0.30	0.17	0.12	0.51	<0.0001	0.088	0.39
American robin abundance	0.039	0.45	0.10	0.41	−0.17	0.26	0.22	0.053	−0.063	0.69
House sparrow abundance	0.011	0.89	−1.02	0.38	−0.11	0.42	0.30	0.0036	−0.12	0.40
Robin+sparrow abundance	0.062	0.50	0.034	0.79	−0.15	0.33	0.22	0.046	−0.092	0.56
Proportion robins+sparrows	0.13	0.17	0.029	0.81	−0.045	0.77	0.21	0.064	−0.0098	0.95
Total bird abundance	−0.037	0.68	−0.023	0.86	−0.26	0.096	0.18	0.11	−0.26	0.11
Bird species richness	0.13	0.17	0.077	0.54	−0.19	0.21	0.078	0.49	−0.044	0.78

Extension Outputs?

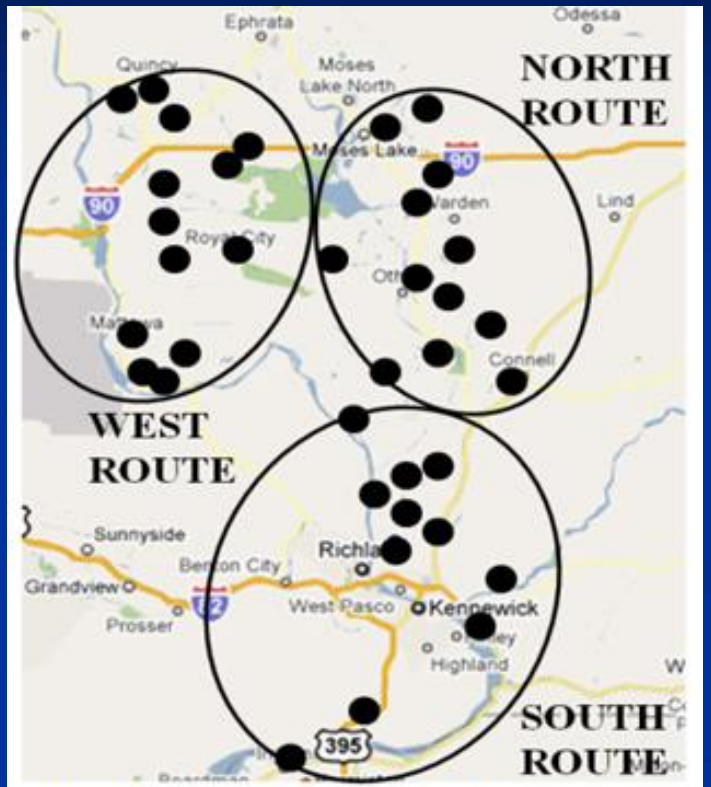
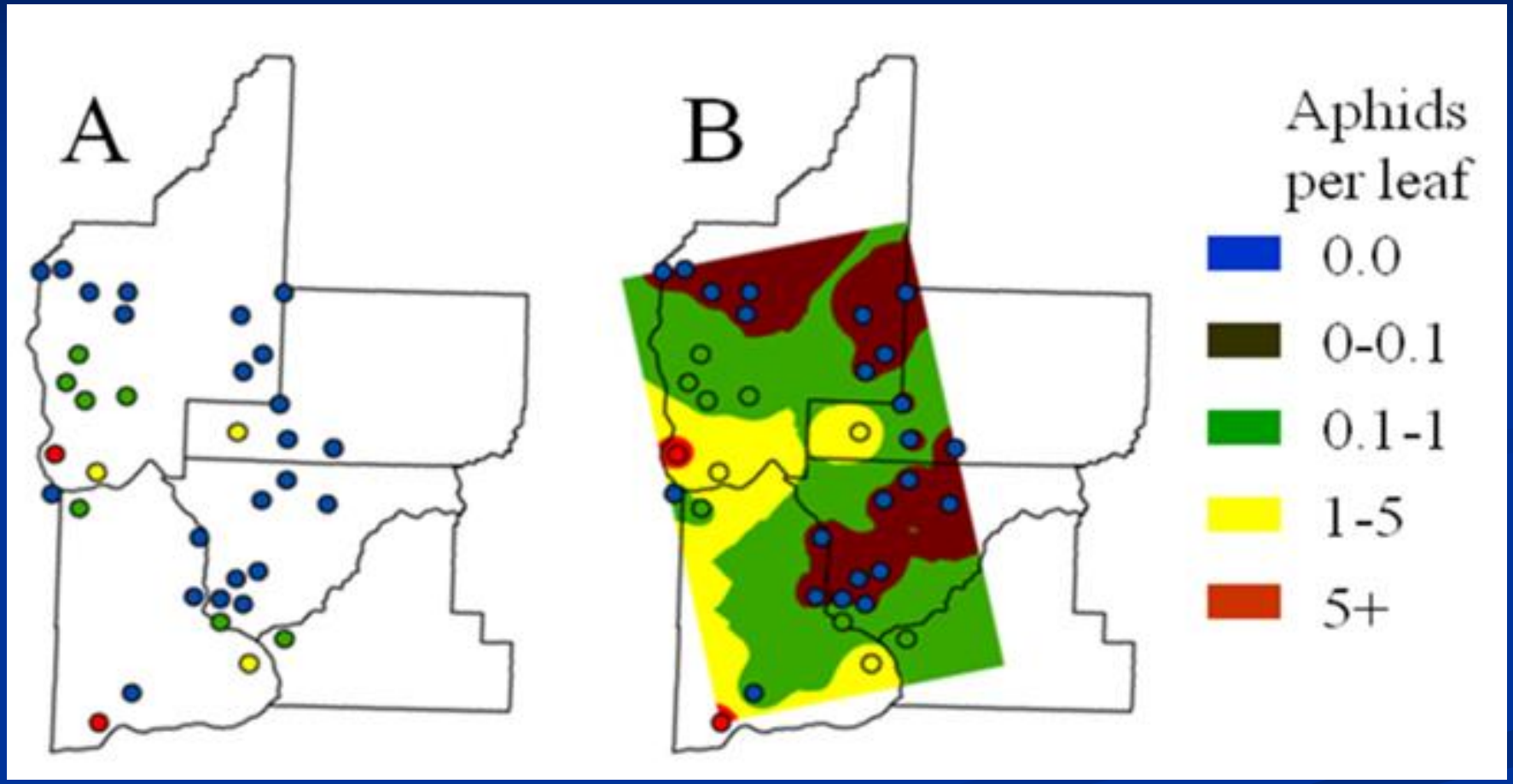


Fig. 1. Area covered by potato sampling routes, along with sampled fields (black circles)

Extension Outputs?



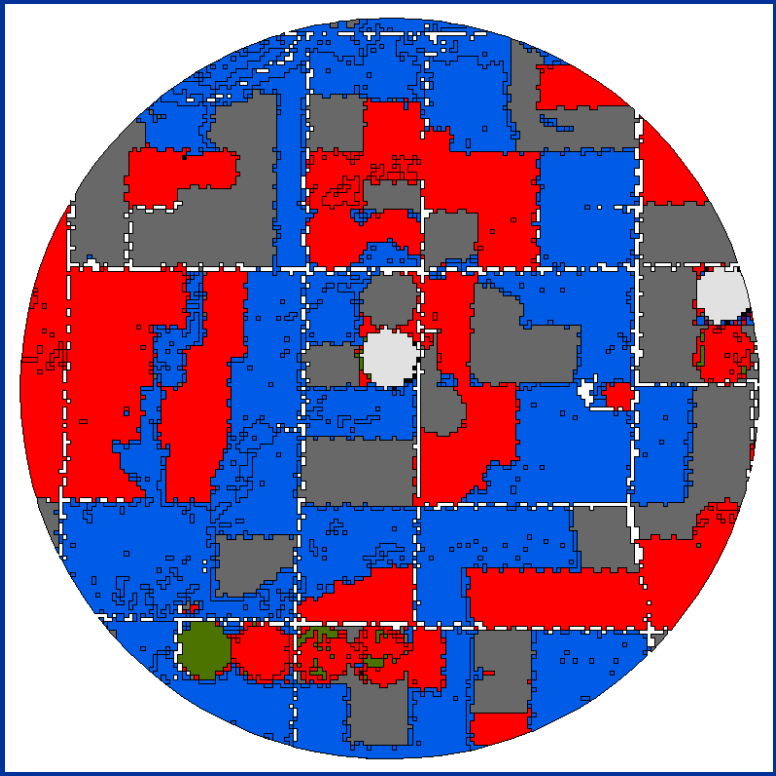
Current Needs

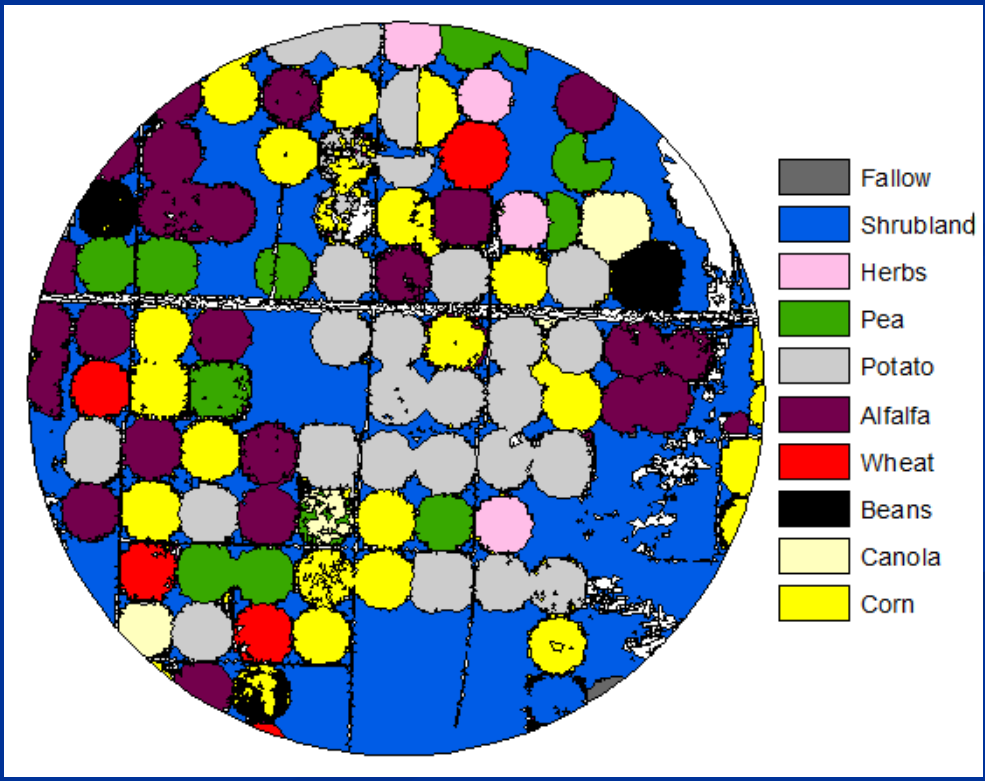
1. Monitoring data –we can work with presence/absence data from short time scales. Moving forward, we want long-term monitoring that is coordinated across the US

2. Vegetation sampling around sites

3. Data on environmental tolerances, or on other factors affecting BMSB occurrence and population dynamics (particularly any variance across haplotypes)

Vegetation sampling





Questions?